What is claimed:

1. a process for manufacture of an in-press coated composite substrate, said process comprising the steps of

forming a coating composition laminate comprising

1) a layer of a primer coating composition comprising a water dispersible thermosetting or thermoplastic polymer, said primer coating layer being formed as a chemically crosslinked polymer matrix, and

2) a layer of a top coat composition including a thermoplastic or thermosetting polymer latex composition;

contacting the primer coating layer with a surface of a compressible mat comprising fibers or particles and a resin binder composition;

compressing the mat and the coating laminate between heated metal surfaces in a press; and

releasing the compressed, polymer coated composite substrate from the press.

2. The process of claim 1 wherein the fibers or particles used to form the mat are selected from cellulose, glass, synthetic polymers and carbon.

3. The process of claim 2 wherein the mat further comprises an inorganic cementitious composition.

4. The process of claim 1 wherein the coating laminate is formed by applying a layer of the primer coat composition to the surface of the mat and applying a layer of the top coat composition over the primer coat layer before compressing the mat.

5. The process of claim 4 wherein the top coat composition comprises a thermosetting polymer and the coating laminate further comprises a layer of a release composition in contact with the top coat layer, said release composition comprising a silicone polymer or a surfactant.

6. The process of claim 1 wherein the top coat composition comprises a thermosetting polymer and the coating laminate further comprises a layer of a release composition in contact with the top coat layer, said release composition comprising a silicone polymer or a surfactant.

7. The process of claim 6 wherein the coating laminate is prepared by applying, in sequence, a layer of a release coat composition, a layer of a top coat composition and a layer of a primer coat composition to a heated metal surface of the press, and the mat is compressed between the laminate coated metal surface and a second metal surface in a press.

8. The method of claim 7 wherein the heated metal surface is a continuous belt.

9. The method of claim 7 wherein an adhesive is applied to the surface of the mat or the primer coat layer before the mat is compressed between the laminate-coated metal surface and the second metal surface in the press.

10. a process for manufacture of an in-press polymer coated composite substrate, said process comprising the steps of

applying a layer of a primer coating composition to the surface of a compressible mat comprising fibers or particles and a resin binder, said primer coating composition comprising a thermosetting polymer or a thermoplastic polymer and formulated to form a chemically crosslinked polymer matrix when applied to the surface of the compressible mat;

compressing the mat and the primer coating layer between heated metal surfaces in a press to form the polymer coated composite substrate; and

releasing the polymer coated composite substrate from the press.

11. The process of claim 10 wherein the polymer matrix on the surface of the compressible mat comprises an ionically crosslinked polymer.

12. The process of claim 11 wherein the ionically crosslinked polymer comprises a thermoplastic polymer.

13. The process of claim 10 wherein the polymer matrix on the surface of the compressible mat comprises a covalently crosslinked polymer.

14. The process of claim 10 further comprising the step of applying a layer of a polymer-containing top coat composition over the chemically crosslinked polymer matrix on the compressible mat before compressing the mat in the press.

15. The process of claim 14 wherein the top coat composition comprises a thermosetting polymer latex.

16. The process of claim 10 further comprising the step of applying a release coat composition comprising a silicone polymer or a surfactant over the chemically crosslinked polymer matrix on the compressible mat before compressing the mat in the press.

17. In a process for manufacture of a polymer coated composite substrate including the step of pressing a compressible mat comprising fibers or particles and a resin binder between heated metal plates in a press to form a compressed composite substrate, the improvement comprising the steps of

applying a polymer-containing primer composition to the surface of the compressible mat before pressing it between the heated metal plates, said polymer-containing primer composition being formulated to provide an ionically crosslinked polymer matrix as it is applied on the surface of the compressible mat; and thereafter

pressing the matrix coated mat between heated metal plates to form a polymer coated composite substrate.

18. The improvement of claim 17 wherein the polymer-containing primer composition comprises an anionically stabilized thermoplastic latex.

19. The improvement of claim 17 wherein the primer composition comprises a thermoplastic polymer latex.

20. The improvement of claim 17 wherein the primer composition comprises a thermosetting polymer latex.

21. The improvement of claim 17 further comprising the step of applying a layer of thermosetting top coat latex composition over the crosslinked polymer matrix before pressing the matrix coated mat between the heated metal plates.

22. The improvement of claim 21 further comprising the step of applying a release coating composition comprising a silicone polymer or surfactant over the top coat composition before pressing the matrix coated mat between the heated metal plates.

23. a polymer coated composite substrate prepared in accordance with the process of claim 1.

24. a polymer coated composite substrate prepared in accordance with the process of claim 10.

25. The polymer coated composite substrate of claim 23 wherein the compressible mat comprises cellulosic fibers or particles and a thermosetting resin binder.

26. The polymer coated composite substrate of claim 24 wherein the compressible mat comprises cellulosic fibers or particles and a thermosetting resin binder.

27. The process of claim 1 wherein the compressible mat further comprises a paper sheet forming the surface of the mat in contact with the primer coating layer.

28. The process of claim 10 wherein the compressible mat further comprises a paper sheet forming the surface of the mat to which the layer of primer coating is applied.

29. The improvement of claim 17 wherein the compressible mat further comprises a paper sheet forming the surface of the mat to which the primer composition is applied.

30. a process for the manufacture of a coated porous substrate comprising

applying a polymer-containing primer composition to the surface of a porous substrate, said primer composition being formulated to provide an ionically crosslinked polymer matrix as it is applied on the surface; and

contacting the primer coated surface with a heated metal plate.

31. The process of claim 30 wherein the primer composition comprises a anionically stabilized thermoplastic latex.

32. The process of claim 30 wherein the primer composition comprises a thermosetting latex.

33. The process of claim 30 further comprising the step of applying a layer of a thermosetting latex top coat composition over the crosslinked polymer matrix before the surface is contacted with the heated metal plate.

34. The process of claim 10 wherein the composite substrate is paper.

35. The process of claim 17 wherein the composite substrate is paper.

36. The process of claim 30 wherein the coated porous substrate is paper.